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SODERZHANIE NEKOTORYKH MIKROEHLEMENTOV V EHRITROTSITAKH, LEJKOTSITAKH I PLAZME KROVI CHELOVEKA

[THE CONTENT OF SEVERAL MICROELEMENTS IN THE ERYTHROCYTES, LEUCOCYTES AND PLASMA OF A HUMAN]

by

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HUMAN ERYTHROCYTES, LEUCOCYTES AND BLOOD PLASMA CANTENT OF SEVERAL MICROLLEMENTS

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Summary

Ni, Zn, Ag, Cu, V, Ti, Al, Pb, Mn and Fe content was determined by means of spectrography in whole human blood, erythrocytes and blood serum. Patterns of the microelements distribution between blood cells was studied.

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The role of a number of microelements (Fe, Co, Cu, Zn) is already sufficiently studied, both in a normal and in several pathological states [1-6]; the significance of yet many other microelements remain unclear, not only in the pathogenesis of a number of diseases, but also in physiological processes. To study the metabolism of microelements information on the quantitative content and on the distribution of them among blood cells are important. A usual concern for the study of microelements' metabolism is the absence of acceptable technics, permitting one to expose insignificantly small quantities of metals.

Geniune work is being devoted to determining the contents of a number of microelements in whole blood, erythrocytes, plasma and leucocytes of healthy humans.

RESEARCH PROCEDURES

10 - 12 ml of blood for research was taken from the vein, as a rule, in the morning hours. To identify individual microelements in whole blood, erythrocytes and blood plasma, 14 - 16 ml was taken from each donor. Leycocytes were extracted from donor's blood. The obtained substance was dried to a constant weight and afterward subjected to calcination by a method, described earlier by us [7]. The residue was dissolved in a 6 H solution of HCl and iron was extracted from a hydrocloric acid solution by I.T. Klimov's method [8].

From the obtained solutions of microelements we extracted chloroform to use in the capacity of a complexing diethyl.dithio.carbamate of sodium and o-hydroxyquinoline. The extraction of microelements, distillation of chloroform, conversion of the concentrate into a spectrographical element were conducted through a method, developed by V.Ya. Eremenko and I.T. Klimov to identify microelements in natural waters [9].

The spectrographic foundation was prepared from the powder of carbon electrodes and sodium chlorid in a ratio of 2:1. As inherent norms [?Co?](2754,6A, 3039,06A) and Sr(3329,9A, 33663,3A) were used. The quantitative determination was conducted by a method of 3 calibrating devices. Photographing the spectrogram was realized with a quartz spectragraph ISP-28 on a curve system and a current flow of 7 - 7.5 amp., an illuminating diaphragm of 2.0 mm, an aperture of 0,008 mm, spans between electrodes of 3 mm, with an exposure of 3 minutes on photoplates type N.

The method [9] simultaneously permits the exposure of the following microelements: Ni, Co, Ag, Cu, V, Sn, Mo, Ti, Al, Bi, Fe, Pb, Mn.

Additionally, Zn, Zr and Cd were defined, which were extracted under those very same conditions [10, 11]. A large quantity of iron, contained in the residue of whole blood and erythrocytes, prevented the determination of may microelements, therefore Fe was isolated from a solution of the residue, and its number was determined through a weighing method. Fe of plasma, among other elements, can be ascertained spectrographically. Sn and Mo were identified only in plasma, since while

identifying Fe from residual solution of whole blood and erythrocytes their partial coprecipitation with a ferrous hydroxide is generated.

The separation of the blood into erythrocyte and plasma was carried out in polyethylene test tubes; calcination of the material - in quartz crucibles. To prepare a spectrographic foundation and a calibrating device a salt of heavy spectral metals or of a specific frequency is used. All reactors and chemical utensils underwent special cleaning. During the entire research program controlled experiments were conducted; through this contamination from metals didn't develop. In the course of all experiments, with accessaries, error in identification of all elements didn't exceed ± 20%. In the researchable samples of blood Co and Bi detection was unsuccessful, Cd was identified only in traces. Thus, the following microelements' quantity was determined: Ni, Ag, Cu, V, Sn, Mo, Ti, Al, Fe, Pb, Mn, Zn, Zr.

RESEARCH RESULTS

1. THE CONTENT OF MICROELEMENTS IN WHOLE BLOOD. In all 75 healthy young people were examined. The microelements quantitative contents in whole blood are presented in Table 1. Our discovered quantities were near (Ni, Cu, Ti) or identical (Zn, Pb, Fe) to the data in the literature and only the number of Al in whole blood appeared 2- 3 times higher, than that recorded through several researches. On the average the content of Ag in whole blood equalled 1.04 mkg%, V - 0.79 mkg%, Zr - 0.95 mkg%.

We found testimony on the presence of silver (Ag) in the blood only in the work of A.O. Vojnar [12]. Information on the content of V and Zr in the blood wasn't discovered by us in the literature. In the human V was detected only in the brain [13].

Data on microelement content in the blood of men and women is presented in Table 2. It can be noted, that Ni, Ag, Mn are present more in women's blood, and Cu, Ti, Fe, - in men's blood.

2. MICROELEMENT CONTENT IN ERYTHROCYTES AND PLASMA. Simultaneously microelements were identified in the whole blood, erythrocytes and plasma of 25 donors. A total quantity of microelements in erythrocytes and plasma matched the discovered quantity in whole blood. The nature of microelements' distribution among erythrocyts and plasma can be ascertained in accordance with the magnitude, presented in Table 3.

Zn, Fe and Pb were detected mainly in erythrcytes, Ni, Zr, Ag, Cu, Al and Mn are contained in erythrocytes in a larger quantity, than in plasma. Ti is uniformly distributed. V was found in the plasma.

3. MICROELEMENT CONTENT IN LEUCOCYTES. Research was carried out on leucocytes from 10 donors. Our obtained information on the quantitative microelements' content in leucocytes is of determined interest, since in the literature we found testimony on contents of leucocytes as Zn only [14, 15]. In the conducted research results the following microelements, in leucocytes, were discovered and quantitatively defined: Ni, Zr, Zn,Ag,

Cu, Sn, Ti, Al, Mn and traces of Pb (Table 3). V, Mo, and Fe were found in leucocytes.

In order to evaluate the level of microelement concentration in blood cells, a calculation of their contents in 100 ml of erythrocytes, plasma and leucocytes was performed (Table 4).

Comparing obtained results with each other, it can be noted, that leucocytes seem to be more saturated microelements (Ni, Zr, Zn, Ag, Cu, Sn, Al), than erythrocytes and plasma. Ti and Mn are present in leucocytes and erythrocytes in equal quantities.

CONCLUSION

Contents of Ni, Zr, Zn, Ag, Cu, V, Ti, Al, Pb, Mn, Fe in whole blood, erythrocytes and plasma were defined and the nature of these microelements' distribution among blood cells was studied.

Таблица 1

1. Содержание микроэлементов в цельной крови

2. Показатели	Ni	Zr	Zn	Ag	Cu	V	Ti	Al	Pb	Mn	Fe
3. Среднее содержание (в мкг%; Fe в мг%)	7,91 ±0,50	0,95 ±0,12	621 ±13,7	1,01 ±0,07	61,2 ±3,14	0,79 ±0,04	6,53 ±0,63	602 ±40,0	33,9 ±2,16	4,01 ±0,20	51,8 ±0,41
4. Количество определений	55	10	75	75	55	42	13	13	42	75	60
5. Среднее квадратичное отклонение	±3,68	±0,1	±118,7	±0,61	±23,3	±0,30	±2,28	±147	±14,0	±1,76	±3,22
6. Показатель относительной точности($\frac{m}{M}$)	0,06	0,1	0,02	0,06	0,05	0,05	0,09	0,06	0,06	0,05	0,008

Table 1

1. Content of Microelements in whole blood
2. Indicators
3. Average content (in mkg%; Fe in mg%)
4. Determined quantity
5. Average quadratic deviation
6. Indicator of relative accuracy (m/M)

Таблица 2

1. Содержание микроэлементов в цельной крови мужчин и женщин

2. Показатели	Пол	Ni	Zr	Zn	Ag	Cu	V	Ti	Al	Pb	Mn	Fe
3. Среднее содержание (в мкг%; Fe в мг%)	5 Мужчины	7,67	—	630,8	0,89	66,9	0,8	7,23	621	33,4	3,72	51,3
	6 Женщины	8,54	—	623,8	1,12	61,25	0,72	6,12	599	31,6	4,11	50,14
4. Количество определений	5 Мужчины	15	—	20	20	15	14	2	2	16	21	20
	6 Женщины	40	—	55	55	40	28	11	11	25	54	40

Table 2

1. Content of microelements in the whole blood of men and women
2. Indicators
3. Average content (in mkg%; Fe in mg%)
4. Determined quantity

Таблица 3

1. Распределение микроэлементов (в мкг%; Fe в мг%) между эритроцитами, плазмой и лейкоцитами

2. Исследуемые препараты		Количество определений 3.	Ni	Zr	Zn	Ac	Co	V	Sn	Mo	Ti	Al	Pb	Mn	Fe
4. Цельная кровь		25	8,05 ±4,1	0,95 ±0,4	631 ±109,6	0,87 ±0,48	60 ±23,3	0,71 ±0,38	—	—	5,33 ±1,7	575 ±119	37 ±15,7	4,1 ±1,8	51,8 ±3,6
5 из 100 мл цельной крови	эритроциты 6	25	4,54 ±1,7	0,67 ±0,4	558 ±122,4	0,65 ±0,27	39 ±15,9	0,73 ±0,4	—	—	2,31 ±0,96	345 ±73	23,6 ±15,9	2,44 ±1,02	50,3 ±3,01
	плазма 7	25	3,8 ±1,9	0,21 —	118 ±30,5	0,44 ±0,16	21,2 ±6,78	0	7,3	0,4 ±0,1	2,39 ±0,7	299 ±72	9,05 ±3,8	1,67 ±1,0	—
	лейкоциты 8	10	0,035 ±0,012	0,018 ±0,004	1,7 ±0,25	0,082 ±0,0006	0,76 ±0,5	0	0,09 ±0,01	0	0,0067 ±0,0037	1,54 ±0,79	След	0,0051 ±0,002	—

9. Примечание. Показатель относительной точности ($\frac{m}{M}$) для результатов в цельной крови, эритроцитах и плазме меньше 0,1, для циркония, обнаруженного в эритроцитах, — 0,2.

Table 3

1. Distribution of microelements (in mkg%; Fe in mg%) among erythrocytes, plasma and leucocytes
2. Research preparations
3. Determined quantities
4. Whole blood
5. From 100 ml of whole blood
6. Eythrocytes
7. Plasma
8. Leucocytes
9. NOTE: Indicator of relative accuracy (m/M) for the results in whole blood. Erythrocytes and plasma are less than 0.1; for zirconium (Zr), discovered in erythrocytes - 0.2.

Таблица 3

1. Распределение микроэлементов (в мкг%; Fe в мг%) между эритроцитами, плазмой и лейкоцитами

2. Исследуемые препараты		Количество определений (n)	Ni	Zr	Zn	Ac	Cu	V	Sn	Mo	Tl	Al	Pb	Mn	Fe
4. Цельная кровь		25	8,07 ±4,1	0,05 ±0,4	631 ±100,6	0,87 ±0,48	60 ±23,3	0,71 ±0,38	—	—	5,33 ±1,7	575 ±119	37 ±15,7	4,1 ±1,8	51,8 ±3,6
5 из 100 мл цельной крови	эритроциты 6	25	4,54 ±1,7	0,07 ±0,4	558 ±122,4	0,65 ±0,27	39 ±15,9	0,73 ±0,4	—	—	2,31 ±0,56	3[illegible] ±73	23,6 ±15,9	2,44 ±1,02	50,3 ±3,01
	плазма 7	25	3,8 ±1,9	0,24 —	118 ±30,5	0,44 ±0,19	23,2 ±6,78	0	7,3	0,4 ±0,1	2,39 ±0,7	299 ±72	0,05 ±3,8	1,67 ±1,0	—
	лейкоциты 8	10	0,035 ±0,012	0,018 ±0,004	1,7 ±0,25	0,02 ±0,00[illegible]	0,76 ±0,5	0	0,09 ±0,01	0	0,0067 ±0,0037	1,54 ±0,79	Следы	0,0051 ±0,002	—

9. Примечание. Показатель относительной точности $\left(\frac{m}{M}\right)$ для результатов в цельной крови, эритроцитах и плазме менее 0,1, для цинкония, обнаруженного в эритроцитах, — 0,2.

Table 3

1. Distribution of microelements (in mkg%; Fe in mg%) among erythrocytes, plasma and leucocytes
2. Research preparations
3. Determined quantities
4. Whole blood
5. From 100 ml of whole blood
6. Eythrocytes
7. Plasma
8. Leucocytes
9. NOTE: Indicator of relative accuracy (m/M) for the results in whole blood. Erythrocytes and plasma are less than 0.1; for zirconium (Zr), discovered in erythrocytes - 0.2.

Таблица 4

1 Содержание микроэлементов (в мкг%, Fe в мг%) в 100 мл эритроцитов, плазмы и лейкоцитов

1 Неслезимые препараты	Количество определений 3	Ni	Zr	Zn	Ag	Cu	V	Sn	Mo	Ti	Al	Pb	Mn	Fe
4. Эритроциты	25	8,65 ±2,39	2,18 ±1,8	1158 ±221,4	1,33 ±0,52	52,0 ±21,9	1,25 ±0,58	—	—	5,16 ±1,44	772 ±151	49,7 ±10,9	1,96 [illegible]	107,2 ±13,5
5. Плазма	25	6,9 ±3,7	1,8	2,5 ±12,4	0,9 ±0,38	52,3 ±13,4	0	13,2	0,79 ±0,21	5,65 ±0,4	947 ±130	17,5 ±2,8	2,6 ±1,03	—
6. Лейкоциты	10	31,9 ±20,1	19,5 ±11,4	1880 ±8,2	3,6 ±2,1	120,1 ±51,9	0	71,1 ±7,1	0	5,06 ±2,2	1125 ±467	Следы	5,04 ±3,3	0

Table 4

1. Content of microelements (in mkg%, Fe in mg%) in 100 ml of erythrocytes, plasma and leucocytes
2. Research preparations
3. Determined quantity
4. Erythrocytes
5. Plasma
6. Leucocytes

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